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Elastic requirements for useful photos, but stringent specifications for the best.

INTELLIGENCE PHOTOGRAPHY

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In the days and months after the Nazi blitzkrieg suddenly overran France, British topographic intelligence, ill prepared to support the evacuation at Dunkirk and subsequent raids on the French coast, resorted to photo intelligence from post cards, travel folders and brochures, and tourist snapshots collected by public appeal.¹ That they were driven to this kind of improvisation illustrates the wisdom of building up in advance an intelligence photo collection even on objects and areas where no intelligence need is foreseen. It also shows that casual photos taken without any regard to the requirements of a photo interpreter can be useful. Nevertheless their usefulness is increased and the interpreter's work eased in proportion as his requirements—most of them stemming from his need to take measurements—are fulfilled.

There are times when a single photograph is *the* documentary evidence upon which a critical decision must be based. The specially skilled personnel of a photographic intelligence center may spend days and sometimes weeks exploring with their computers and precision measuring devices a single 35 mm. negative, extracting information that could not be imagined to reside in it. It may yield only one required fact, but sometimes that tiny piece of acetate and silver becomes the key to a cabinet full of hitherto inaccessible secrets. In the story of the Yo-Yo missile guidance system told in a recent issue of the *Studies*,² photographs of a grass-covered bunker ending in two large triangular discs provided the critical information that led to a break-through.

¹ See James Leasor's *The Clock with Four Hands*, reviewed in *Studies* IV 1, p. 99.

² V 1, p. 11 ff.

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CONFIDENTIAL

Photography

The history of these Yo-Yo prints also illustrates the tribulations imposed on the photogrammetrist trying to get his measurements when the necessary technical data does not accompany the film. The make of camera that took them was not reported, nor the focal length of the lens, nor any estimate of camera-to-target distance. Even the size of the negatives was uncertain, there being no black border to show that they had not been cropped. Nevertheless a crude indicator for scale was found—a number of cows shown beyond the bunker in one of the pictures. These were identified as of the Angus breed, the average hip-to-ground height of Angus cattle was obtained from the Department of Agriculture, and the task of triangulation could begin. The resulting measurements of the visible parts of what turned out to be a new kind of radar system were later verified by repeated photographic coverage as being within 10% of the actual dimensions.

Measurements

When the focal length of the lens and the camera-to-target distance are known, the scale of the image on the negative is immediately available as their quotient. Measurements of the target's image, usually made in hundredths or thousandths of a foot, can be converted by this scale into the target's true dimensions:

$$\text{image dimension} \times \frac{\text{distance}}{\text{focal length}} = \text{true dimension}$$

The scale will be accurate, of course, only for objects in a plane at exactly this distance from the plane of the camera lens; the computation of the size of objects shown nearer to the camera or farther away is more complex.

If the focal length is not reported, but an object of known size—preferably something better standardized than cows—is shown, the scale will be the quotient of a measured dimension of that object's image by its true dimension; and the size of other objects in the same range plane can then be found with the formula:

$$\begin{aligned} &\text{unknown image dimension} \times \frac{\text{known true dimension}}{\text{known image dimension}} \\ &= \text{unknown true dimension} \end{aligned}$$

Photography

CONFIDENTIAL

For the most accurate measurement of fine detail, however, the photogrammetrist uses angular measurements and trigonometric computations, based on the angular field of view of the lens and the size of negative used in the camera. The standard 50 mm. lens for a 35 mm. camera, for example, takes in a horizontal angle of 38.2° and a vertical angle of 26° , while a 400 mm. telephoto lens takes in only $5\frac{1}{2}^\circ$ by $3\frac{1}{2}^\circ$. At a given range the lateral distance from the center point of the field of view to one of its extremes will be the product of the range distance by the tangent of half the maximum angle in question.

Fortunately, measurements are not always needed, even of military equipment in denied areas. Specialists on the type of equipment in question can often identify a known model by its distant, poorly defined silhouette, and the knowledge that such a piece of equipment was seen in that location is what is important. New models or modifications of old ones are a different matter; their capabilities have to be determined by the measurement of critical parts. And here especially the refinements that make the difference between a tourist snapshot and the most informative photograph, while small, are important. They are of two kinds, qualities inherent in the negative itself and a sufficiency of accompanying data about it.

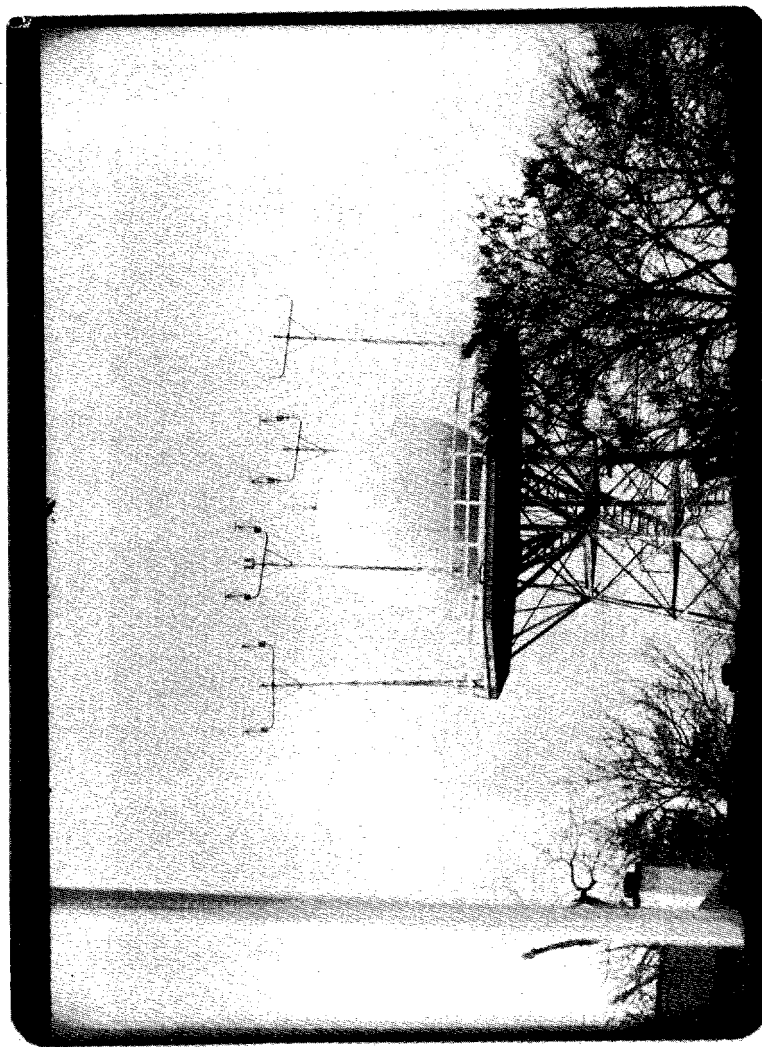
Photographic Requirements

The first requirement is the highest resolution—sharpness of image—of which camera and film are capable. It can be achieved by focusing the lens properly, by holding the camera steady, and by using a relatively high shutter speed ($\frac{1}{100}$ th second or faster) to minimize camera and subject movement. The film, when there is a choice, should also be selected with a view to resolution; and here, unless light is good and motion minimal, it is necessary to compromise between fast film and the slower fine grain. Panatomic-X (ASA 25) or its equivalent is an excellent choice when light conditions are good and the finest detail is necessary. For poor light or when a very fast shutter is required, films such as Tri-X Pan (ASA 200) should be used. As a compromise, Plus-X Pan (ASA 80) is the best all-purpose film. Color film is desirable only when color is an important feature of the subject; that now on the mar-

CONFIDENTIAL

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Photography



Print from 35 mm. negative taken with a Lietz 400 mm. telephoto lens
at a distance of 700 feet. Note the required black border.

Photography

CONFIDENTIAL

ket gives rather poor resolution as the color fringes blur into one another. With improvements, film of the type of Eastman's Kodacolor may in the future be the answer to this problem.

The second requirement is that photographs not be cropped. If a print is submitted it should be made from the full negative. The analyst's ability to take fine measurements from a photograph is keyed, as pointed out above, to knowledge of the angular field of view of the camera lens and the size of the negative used. If a print has been cropped or masked, the angular relationship is left without its frame of reference. But if prints are made with a little of the negative's clear margin showing on all four sides, the resulting black border assures the interpreter that he is working with the full frame.

Third, if a print is submitted, the contrast should be neither light nor heavy, but medium. The details important to photoanalysis are frequently in shadow areas, which would be blackened by heavy contrast. But whenever possible, the original negatives, not prints, should be submitted. The best of prints will contain only about 35 of the 200 to 300 different tonal shades of gray that the negative may have, and each tone may represent additional information. The photogrammetrist, to be sure, will not use the original negative for fear of damaging it, but he will make a positive transparency that has all the qualities of the negative by contact printing on a piece of film designed for this purpose.

Accompanying Data

The analyst can sometimes improvise, as we have seen, but he will be able to get the most out of each photograph if it is accompanied by the following information:

Where the picture was taken—geographic location, province, city, town, and as nearly as possible the exact position. On a train the notation might be, "Ten rail clicks south of milepost 147 on x-y rail line," or on the highway, "300 yards SSE of intersection of highways N30 and N12." Further, the compass direction in which the camera was pointed; the more accurate the azimuth reading the more valuable the photo will be.

CONFIDENTIAL

CONFIDENTIAL

Photography

Date and time. Precision as to the time of day within five minutes will give the analyst a secondary method of making height determination by reference to astronomic data on sun position computed for the area in question.

Make and model of camera; different models may have different frame sizes, the Robot "Star," for example, producing a 1" by 1" negative and the Robot "36" a 1" by 1 3/8". Paramount is the importance of recording the focal length of the lens, which is always engraved on the front of the lens rim.

Camera-to-subject distance, with method of measuring it—paced, map reference, eye estimate, etc.

Any unusual conditions at the scene—sounds, smells, colors, smoke, anything that might help to identify an unknown activity.

For all these purposes some system of numbering the exposures to key them to the data is necessary. Film for 35 mm. cameras is convenient in this respect because each frame is numbered during manufacture.

Special Techniques

Every lens has a distortion pattern of its own, displacing the photographic image from its true position. When the camera and lens to be used on a photographic mission are available to the photo analyst, he has them calibrated on an optical bench, recording the distortion pattern of the lens and the precise alignment between lens and plane of film. This calibration in advance is not often possible, but the photographer can easily provide calibration data himself. He stands, with his camera, between two parallel lines, such as the curbs of a street, or even better a straight stretch of railroad tracks, and makes one exposure looking down these lines with camera held level in normal position. Then he turns the camera 90° about its lens axis so that the horizontal dimension of the frame is vertical and makes a second exposure of the same view from the same position. If these two negatives are submitted along with the photos taken by the camera, the optical technician can plot the pattern of distortion and compute its effect on measurements in the latter.

Photography

CONFIDENTIAL

A real photographic study of a subject requires views from various positions, even if they can be taken from only one direction—distant views to show the entire area and the position of the subject in its environs; medium ones for definition of the relationships of components of the subject to each other; close-ups for details of structure, size, and functioning of individual components. These three kinds of view can be taken either by moving progressively closer to the target or by successive use of wide-angle, normal, and telephoto lenses. There is no such thing as too many photographs of a subject, particularly of telephoto views, in which atmospheric interference and the foreshortening of the field present additional problems to the photo interpreter.

When a subject is too broad or tall to get into a single frame, it can be covered by a series of exposures—a procedure called panorama or partial cyclorama. The photographer takes a position at an identified point and starts with a picture of one of the extremes. Then from the same position he takes a second shot with a 30% to 40% overlap of the first, and so continues until he has covered the area. If possible, this procedure should be duplicated from a second or even third position, recording the relationship of each camera position to the others.

Of all the techniques used in ground photos, stereophotography probably has the greatest versatility and value. The simulated third dimension can be of great help in distinguishing between components of a subject or several similar objects in proximity to one another. Although 35 mm. stereo cameras are available on the market, they are of little use at distances beyond 50 or 60 feet. Stereophotographs at greater distances are best made with an ordinary camera, taking pictures of the same object from two or more slightly separated stations with the optical axis of the lens parallel in all shots. As a rule of thumb, the distance between camera stations should be one foot for each 100 feet of range. This distance, called the stereo base, should be reported. Stereophotographs can be made from a moving vehicle by holding the camera in fixed position and making successive exposures as rapidly as possible. The interval between exposures and the speed of the vehicle, if they can be estimated, will provide a stereo base.

CONFIDENTIAL

15

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Photography

These refinements of technique, together with accurate and complete data accompanying submitted films, enhance the intelligence value of reports based upon photography. But the elaboration of sophisticated requirements should not be allowed to obscure the most important requirement: *Take pictures.*

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*Intelligence market for the
product of the camera fan's fun.*

SNAPSHOTS AT RANDOM



25X1

Everyone who has taken photographs in a foreign country has collected potential ground photographic intelligence. The traveller turns his camera upon anything that excites his interest—the civil engineer on peculiarities in the construction of dams, roads, bridges, and city buildings; a woman perhaps on clothing, jewelry, and hair styles; a doctor on things related to disease and therapy; a farmer on crops and tools and methods of farming. The more widely travelled the man behind the camera and the broader his interests, the more discriminating he is likely to be in photographing subject matter peculiar to a particular place. But the potential intelligence thus collected is often lost; there are two minimum requirements for transforming it into actual photo intelligence. One is that the pictures must be identified, at least by the name of the place or subject, the direction the camera was facing, and the date. The other is that they must get to the market.

The most omnivorous and insatiable broker for the photo intelligence market is the CIA Graphics Register. If you have a batch of photos taken anywhere abroad, properly identified and preferably with negatives, the Register would like to look them over. If they were taken in London or Paris or Vienna, say, the pickings may be slim, but the Register would like to decide for itself. And if it knows in advance that you are going to have a tour in some less well frequented place, it may be interested enough in promoting your hobby to supply you with camera and film. With a minimum of effort, adding to the pictures you normally would take anyway a notation of the place, time, and direction and as much descriptive data as you can, you are likely to produce some useful photos.

Targets of Opportunity

The results will be much better, however, if you add to this minimum effort a little more and become as familiar as you

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Snapshots at Random

can with photo collection manuals and lists of requirements on the area. Graphics Register can refer you to general publications on these subjects;¹ and attaché offices in all the U.S. diplomatic missions have such manuals and requirements lists in detail for their particular areas. You can pick out of the listings a few things that are of interest to you and accessible for photographing in the course of your normal day-to-day activities. One standing requirement, for example, is photographs of prominent persons in almost any field, especially the military, political, economic, and scientific. If an election is coming up and campaigning is in progress, why not take a few pictures of the speakers? If they are within 50 feet of a 35 mm. camera, the heads can be enlarged to an identifiable likeness. The closer the better, naturally, but the main thing is to get them on film and in focus.

The fact that an object may have been photographed previously by no means disqualifies it: changes, or the absence of changes, in it over a period of years or of weeks may be important. And changes aside, it is amazing how many pictures of the same object can be taken without telling the whole story. Although I must have seen hundreds of photographs of the Eiffel Tower before I went to France, it wasn't until I walked under it that I realized the first balcony has a big hole in it. So looking up, I photographed the tower through the hole; and then, just for fun, I kept trying to find another photograph that showed there was such a hole in the middle of the balcony. It was three and a half years before I saw one. A good photographic practice is to take the normal view of an object and then try to think up a different viewpoint and take that also. Few people look up, and it is often by looking up that you find an extraordinary picture.

If a new gas storage tank is being built in the city where you are stationed and you drive past it going to work every day, why not photograph it once a week or once a month? The photos will tell how long it takes to build it, what types of materials and methods of construction are used, and how much gas storage capacity is being added. Maybe you don't know what a gas storage tank looks like, and all you see is a

¹ See appended bibliography for a sample list.

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big tank being built. Take a picture of it anyway; obviously it is built to store something. What you don't know about it the analyst will. That is what he is an analyst for, but he can't analyze it if you don't get him the pictures.

Captions

A bit of extra effort put into captioning your shots will pay off, too. One kind of information you may not be in the habit of noting for your own purposes, technical data, may be of importance to the Register. This includes the kind of camera and lens, the type of film, and the speed of exposure, as well as a serial number for each roll and frame. You should especially make note if you have used a telephoto or wide-angle lens. Information on the type of film and exposure speed will not only assist in its development but also make it possible for you to get advice on how to correct any mistakes you make and improve your technique.



*Roll 20, frame No. 3. 2 May 1959. 1100 local time.
Malaya, Kelantan state. Town, road, waterway.*

Main road between Kota Bharu and Kuala Trengganu looking south at ferry toward village of Jerteh. Note cut at right for bridge under construction (see frames 1 and 2 for other shots of bridge).

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Most important, however, is good identifying data about each picture. The essential elements are the date (and the time of day may be useful); the precise place; the subject or subjects, with special note of particular features of intelligence interest; and the direction the camera was facing, by compass or with reference to landmarks. It might be noted, for example, that frame no. 7 of roll 2 was exposed at 1330 on 17 November, one mile east of Otaru, Hokkaido, on the road to Sapporu, looking north and showing a Soviet trawler in the bay. Or from a second-floor street window of the Hotel Europe in Bangkok, looking down on a passer-by identified as so-and-so on his way to the corner to hail a samlor.

These essentials can frequently be supplemented to advantage with additional comments or with printed matter bearing on a particular picture. Perhaps the idea of the target came from facts you read in the newspaper; clip the article out and send it along. You find your way around unfamiliar cities with the help of guidebooks, free tourist maps, and maps bought at local survey offices or book stores. The analyst can use the same material to find his way around your photographs; if you can't send copies, at least make reference to the tools of travel you used. In the absence of printed material it is extremely useful to draw a sketch showing the relationship of pictured objects. A sketch is particularly good when there are several shots of the same subject from different vantage points, or of different subjects near each other, or of subjects that are not mapped. The analyst never complains that he is given too many facts about a picture.

Spies and People

You may want to shoot beyond your targets of casual opportunity and make trips or excursions expressly for the purpose of getting useful pictures. Fine; but since you are presumably abroad on some other government business, it is paramount that you remember you are taking pictures for fun. You should never take photos at the risk of your proper work, your purpose in being there. This need for discretion is of course a greater limitation in some places than in others. Once you have decided upon a target, the thing to do is become as familiar with it as possible, learn for sure just what the limitations of law and discretion are, and forget completely

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why you want the pictures. Try to take them for some other reason than intelligence collection.

I once wanted to photograph a new electric power plant in Malaya. So far as I knew, nobody would question my taking the pictures; but it is a little odd for a girl to go around photographing power plants. First, I had to find it, somewhere around a certain town. I drove out the main road from that town, which finally passed under some high power wires. After taking pictures of the road in both directions, and the wires and towers in both directions, I drove on, planning to take the next road turning off either right or left parallel with the wires. But at the next turn a sign pointed to the power plant.

I photographed the side road and then drove down it until I came to a one-way bridge with a policeman at each end and the power plant on the other side. The first policeman waved me to a stop. I got out of the car, camera in hand, and went up and asked him why. He said I had to wait a few minutes, the Sultan was coming. I asked what was the big building on the other side of the river. "That's our new power plant," he said proudly. "That's nice," I said, "Does it work now?" "Oh, yes." "Golly," I said, "Can I take a picture of it?" "Sure, why don't you go to the other end of the bridge, you get a better shot." So I shot a lot of pictures, some including the bridge and a nearby railway bridge, with a lot of kibitzing, until the Sultan came past in his Mercedes. Then I thanked the policeman and left, congratulating myself that nothing could have been easier. If I'd been as smart as I thought I was I'd have got a good picture of the Sultan and one of the policeman. No matter how much you see, if it isn't in your camera it's worthless.

The biggest hazard to the camera fan who has ulterior motives is people—himself, ordinary people, and people who might suspect him. If you act suspicious even the ordinary people will become suspicious. If you act quite ordinary even the suspicious people will think you quite ordinary. That is why it is important for you to forget the reason you are taking your pictures. Just take them; but know what you will say if you are questioned. Sometimes if people are watching me take pictures it makes me nervous, so I retaliate by turning my camera on them to make *them* nervous. In the places

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Roll 27, frame 11. February 1960.

Burma, Kachin state, Shwegu village. Sociological.

Man cutting bamboo.

I've been they are either so pleased they stop being inquisitive or suspicious or else they are embarrassed and go away. I have been told that in the Middle East they often throw things, and that in the Soviet bloc it can be quite dangerous; but in Asia usually they giggle. Some friends of mine in Borneo used a polaroid camera to divert the people with pictures of themselves while they took candid shots. One Dyak requested a photo of the tattoo on his back; he had never seen it!

The necessary equipment for ground intelligence photography consists of one camera and plenty of film. A camera, like a pair of shoes, is an individual and personal matter. I prefer a 35 mm. negative because its 20 or 36 frames per standard roll last longer without changing film, and larger cameras are too heavy and bulky. I would not use a smaller one, of the subminiature class, except for some special reason; the negative is so small that enlargement potential is seriously limited. And ordinary people, if they bother to think about it, think spies use tiny cameras that can be hidden. If you

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go around more or less like a tourist with a popular-sized one you avoid being conspicuous.

There are many publications on cameras and photographic techniques, on special lenses, on the respective advantages of black-and-white and color, of fine-grain and fast film. I haven't tried to touch on these subjects. All I have tried to do is point out that an opportunity exists for travellers interested in photography to make a considerable contribution to basic intelligence through collecting ground photos. I collected them because I thought it important, because it helped me learn about the place where I was living, and because it was fun.

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